

Reflective Cracking Studies at Virginia's Accelerated Loading Facility

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Outline

- Interest in reflective crack mitigation
- Recent research experience
- Overview of Virginia's APT
 - Why APT?
 - Instrumentation
- Trial asphalt mixes
- Expected outcomes



The problem

- Reflective cracking over jointed concrete is a major problem in VA
- Many major thoroughfares = no reconstruction
- Overlays often 1.5 - 4 in thick
- In some cases cracks propagate after only 1 year



VTRC / VDOT's Approach

- Ideal solution will:
 - Be applicable in many situations
 - Can be specified without sole source procurement
 - Limit changes to construction practice
 - Fall within normal QC/QA practices
- What forms may this come in?
 - Modified binders
 - Mix additives
 - Interlayers

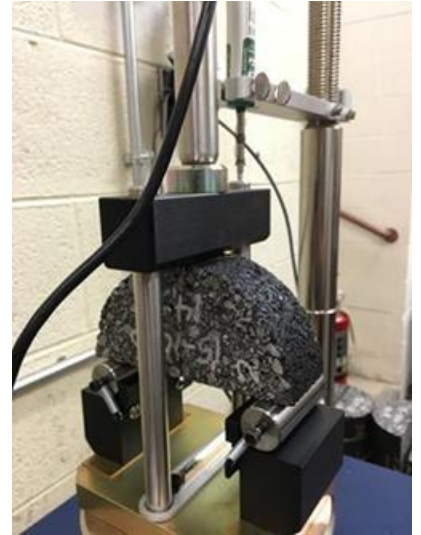


Recent Research Experience



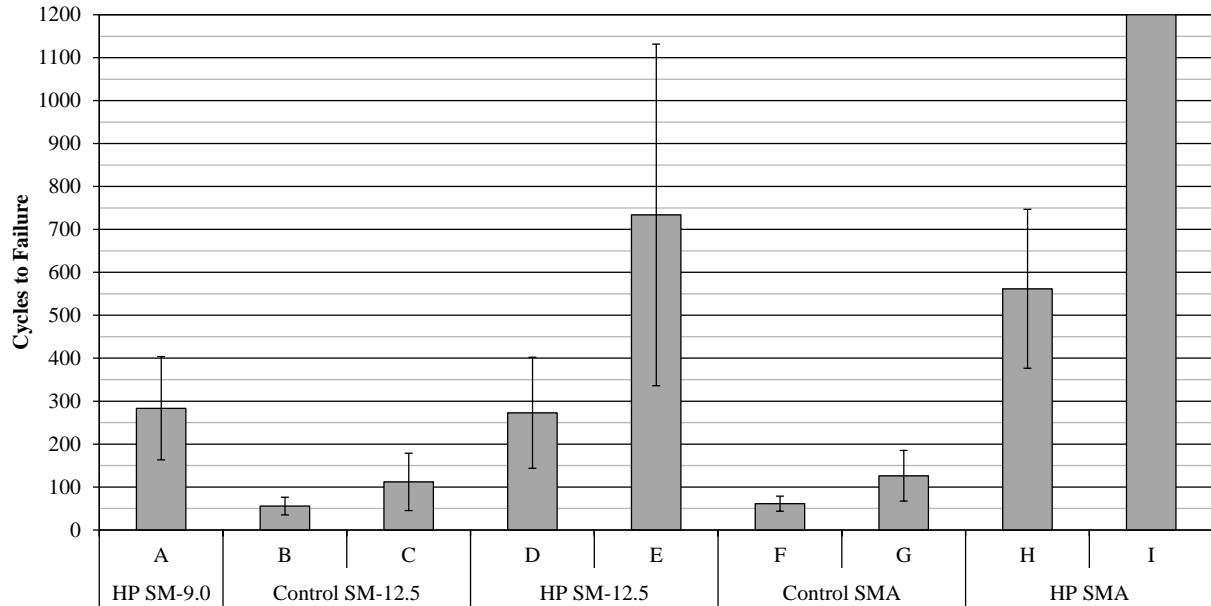
Recent Research Experience

- Use of highly modified (HP) binders (~7.5% SBS)
- HP Phase II project – Overlay Jointed Concrete
 - Comparing different HP mix types
 - SM-9.0 – NOVA District (I-95)
 - SMA-9.5 – NOVA District (I-95)
Richmond District (I-95)
 - SM-12.5 – NOVA District (I-95, I-495)
 - Many lessons learned
 - Material is performing very well
- What mix type is most effective?



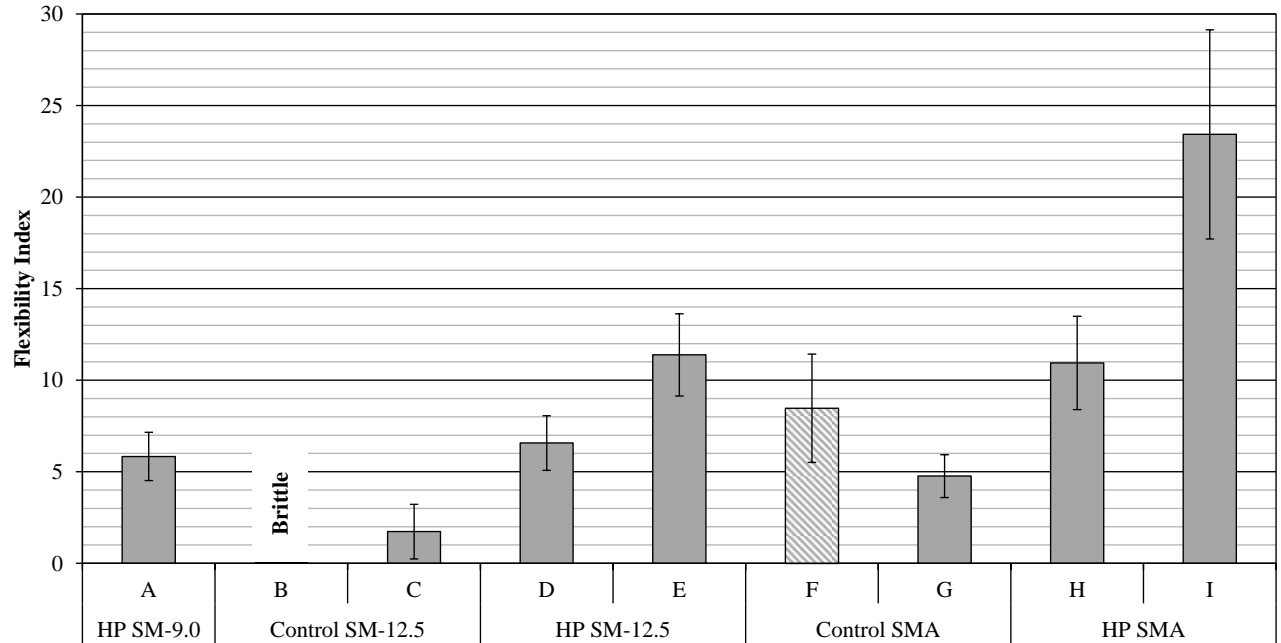
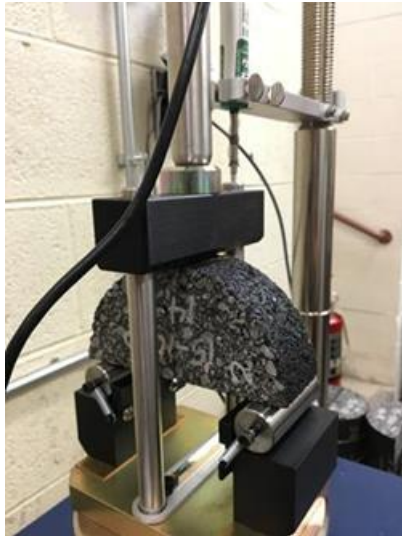
Overlay Test

- Higher = better



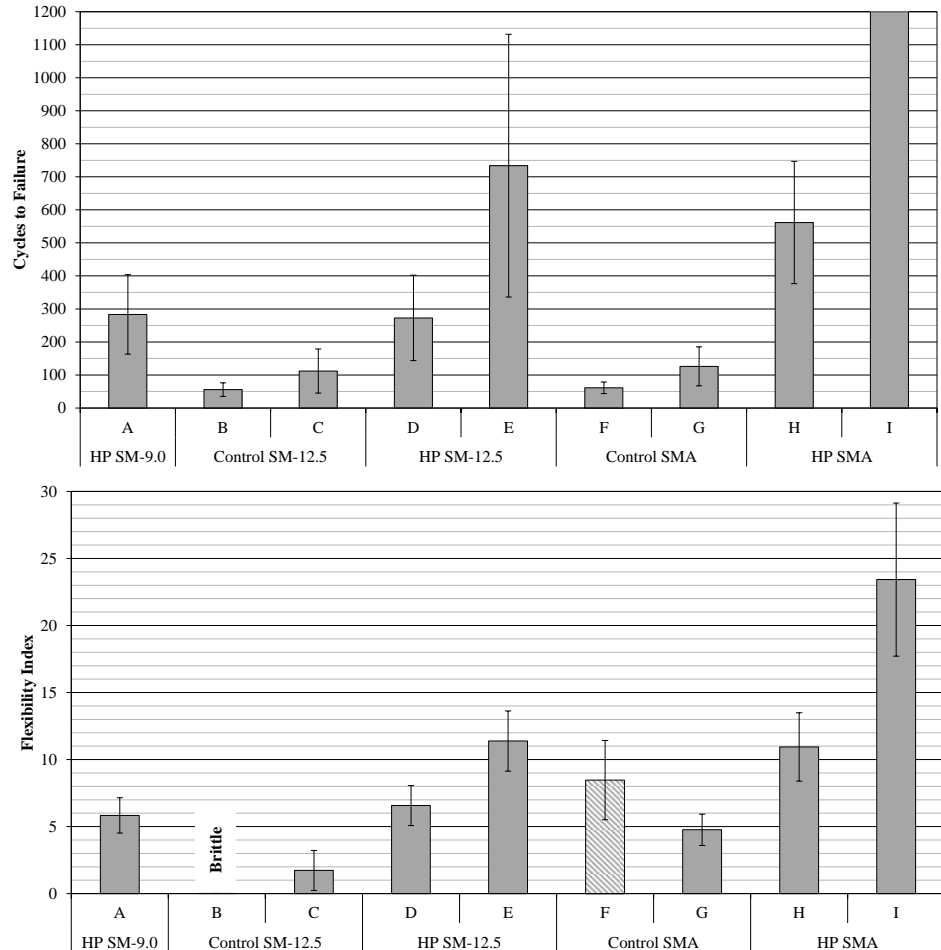
Semi-Circular Bend (I-FIT)

- Higher = better



What does it mean?

- Crack tests correspond
- HP outperforms control in most cases
- HP SMA general performs better than dense graded mix
- Will this hold true in the field?



SM-12.5

- I-95 MM 148.09-151.94
- Two winters, some cracks appearing



SMA-9.5

- I-95 SB MM 159.2-161.34
- Most issues relate to need for HP-SMA best practices
- Fewer cracks



Other ongoing studies

- Examining paving fabrics
 - Trial sections placed in York County over jointed concrete with existing asphalt overlay
- Fiber interlayers
 - Project in planning phase



Accelerated Pavement Testing

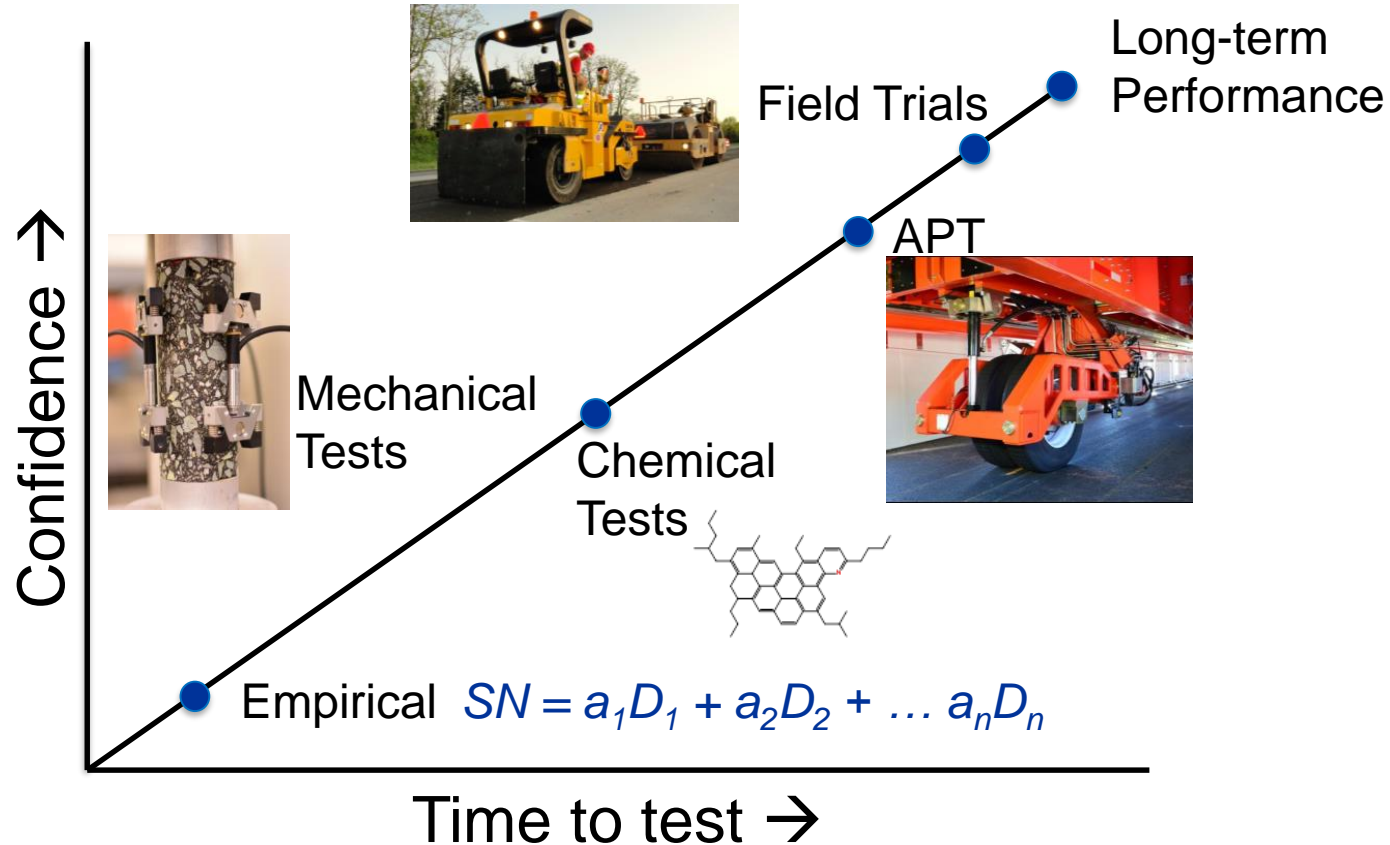


Accelerated Pavement Testing

- A means to study pavement performance
 - Under controlled conditions, more rapidly
 - Less risk to traveling public/agency
 - Simulate loading and temperature



Testing Relationship



VTRC/VDOT and VTTI



Dynatest HVS,
Mark VI
With 6m extension
beam

HVS, Mark VI

- Test length (constant wheel speed)
 - 25 feet to 45 feet (with extension) – run in “short mode”
- Loads applied
 - Up to 22.5 kips
 - Usually we use 9, 12, and maybe 15 kips
- Passes per day
 - 6,000 unidirectional per day is typical (up to 7,000+)
- Investment
 - About \$3 million for the machine





Virginia Tech
Transportation
Institute

VTTI

Virginia Tech
Transportation
Institute

300 feet



2D

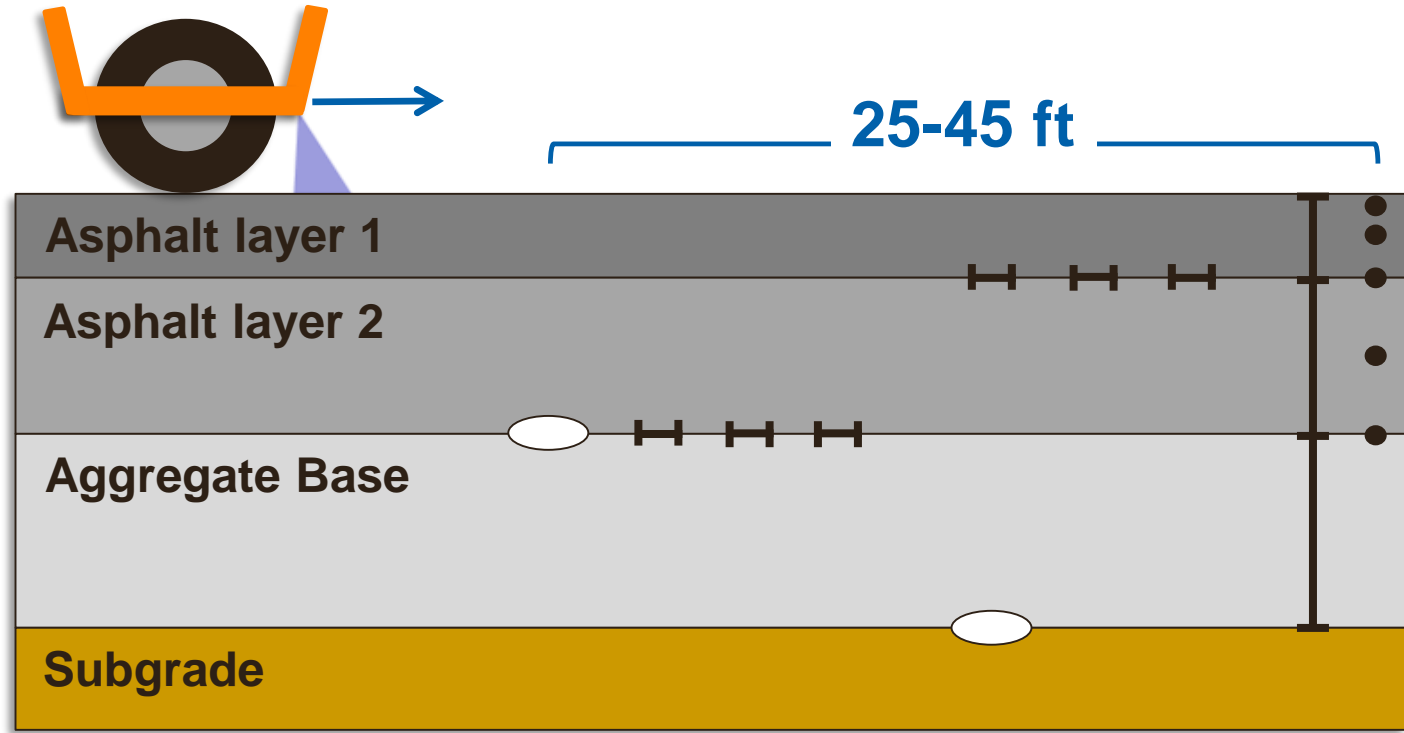
Lane 6	Lane 5	Lane 4	Lane 3	Lane 2	Lane 1
3" SMA	3" SMA	3" Surface Asphalt 65 gyr	3" Surface Asphalt 50 gyr	Surface Asphalt	Surface Asphalt
8" jointed concrete	8" jointed concrete	Intermed Asphalt	Intermed Asphalt	Cold Recycled Asphalt	Cold Recycled Asphalt
6" Compacted Aggregate (21B)	6" Compacted Aggregate (21B)	6" Compacted Aggregate (21B)	6" Compacted Aggregate (21B)	6" Compacted Aggregate (21B)	6" Compacted Aggregate (21B)
Compacted Subgrade (CBR 7.5)	Compacted Subgrade (CBR 7.5)	Compacted Subgrade (CBR 7.5)	Compacted Subgrade (CBR 7.5)	Compacted Subgrade (CBR 7.5)	Compacted Subgrade (CBR 7.5)

- Lanes 1 & 2
 - Different overlays on CCPR base
- Lanes 3 & 4
 - Study of mix design parameters (gyration levels)
- Lanes 5 & 6
 - Reflective cracking study



Instrumentation





Pressure Cell



Horizontal Asphalt Strain Gauge



Rut profiler



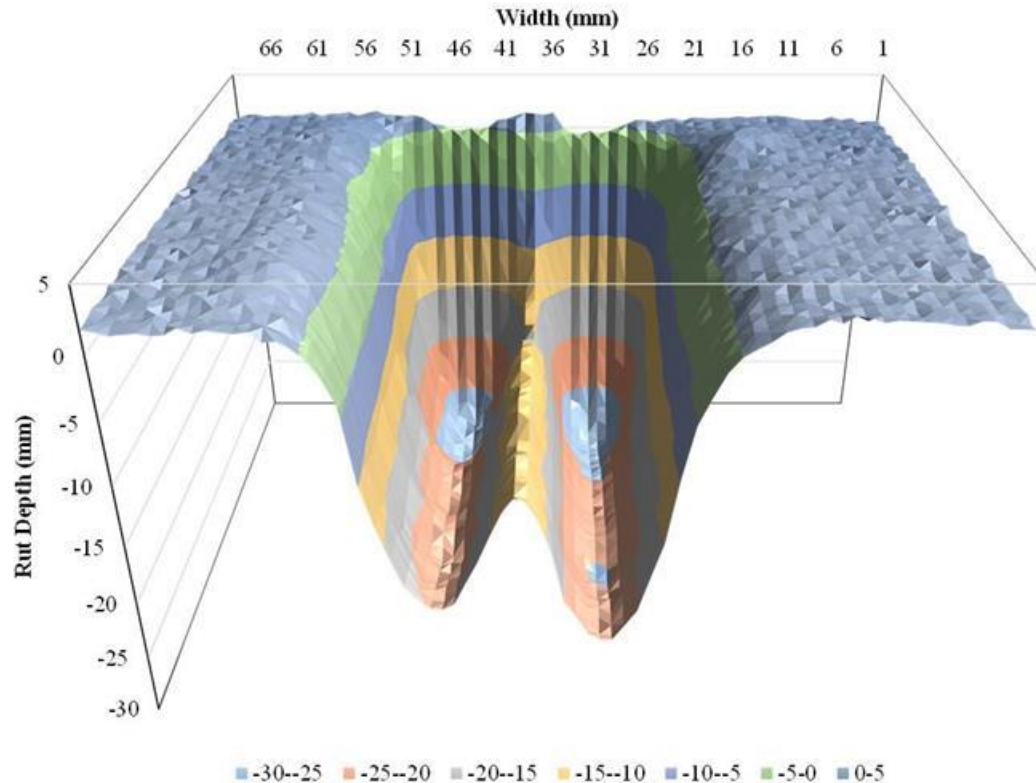
Temperature Probe

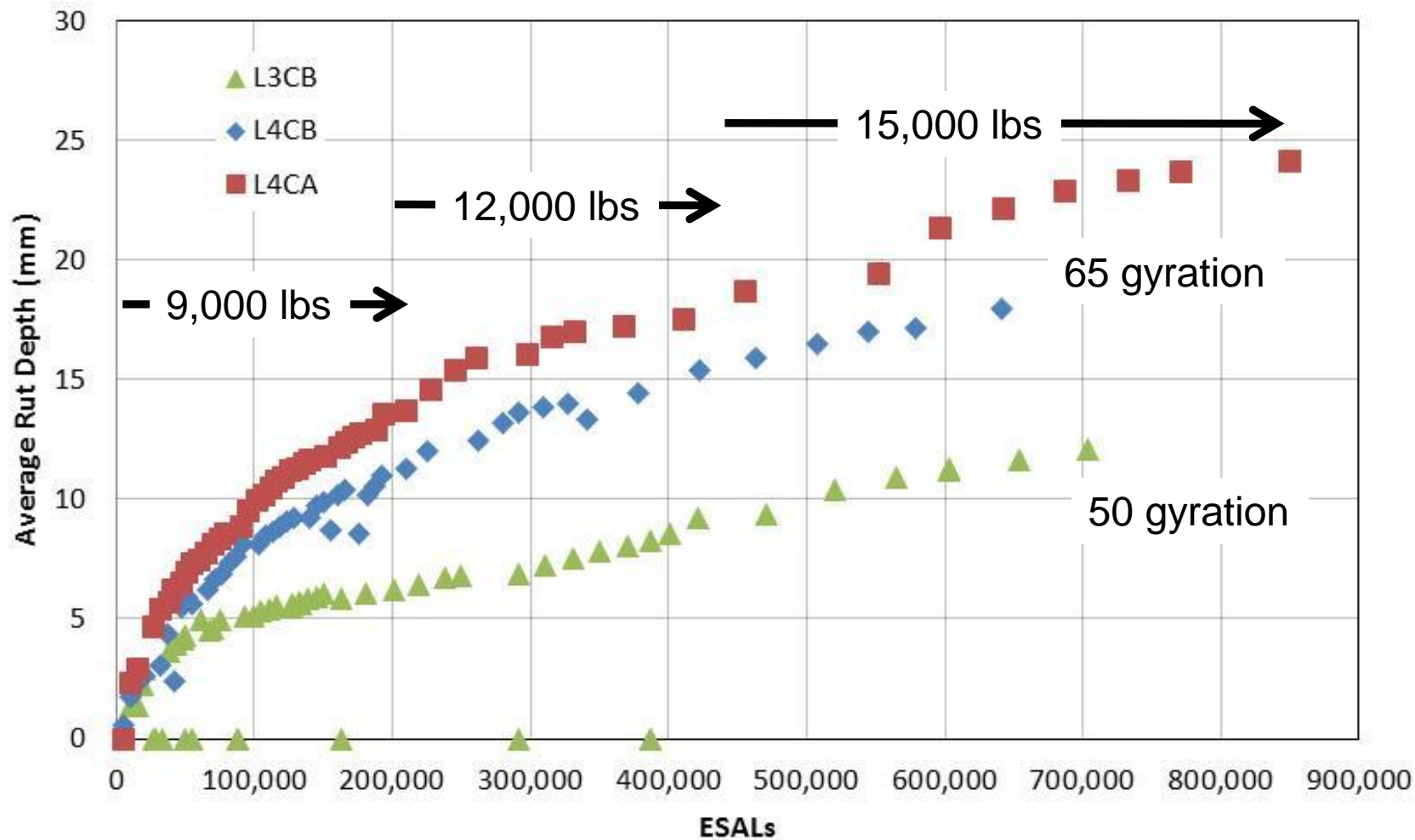


Multi-Depth Deflectometer



Rut profile







*Hardened
asphalt binder
with a soil nail*





Reflective Cracking Study

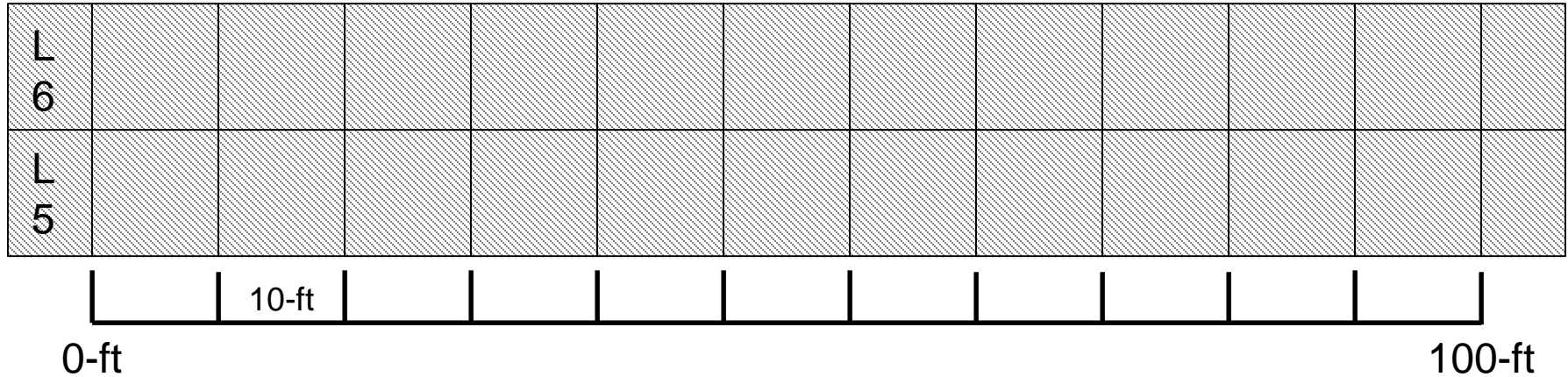


Concrete Slabs

- Specifications
 - 8 in. thick
 - 10 ft wide
 - 300 ft long
 - 10 ft saw cut joints
- Placed on top of ~1 in of SM-9.5



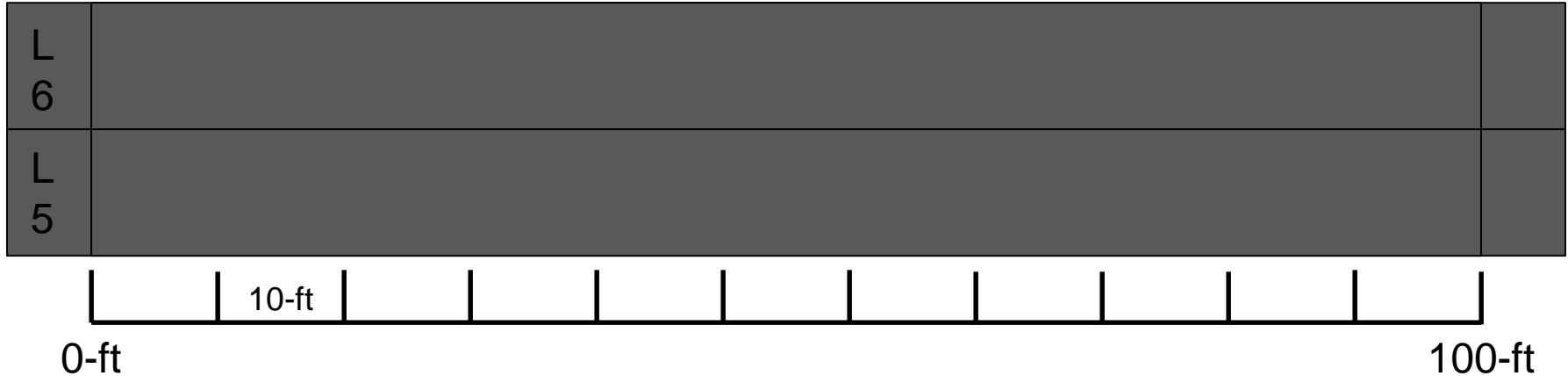
Slab layout



- Series of 10x10-ft slabs
- Overlay with experimental mix



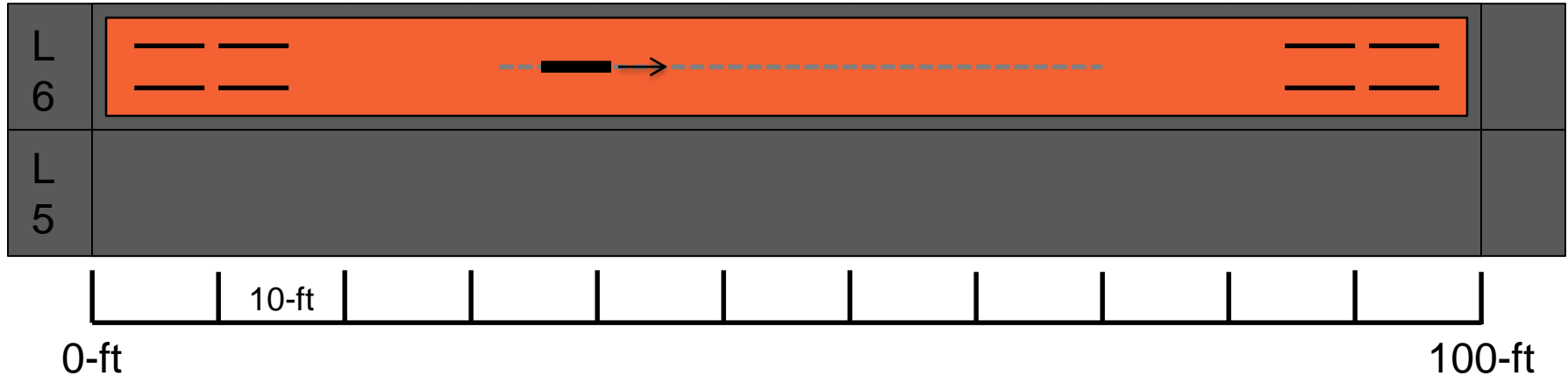
Section 1



- Place instrumentation
- Pave with control or experimental mixture



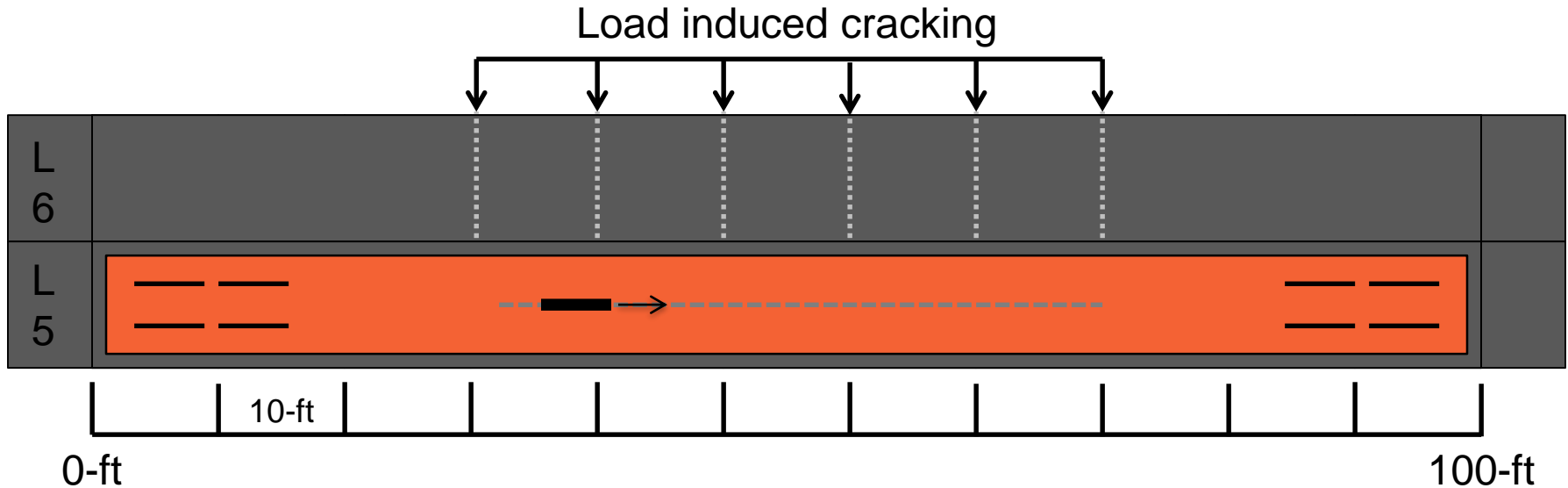
Section 1



- Loaded wheel influences ~6 joints
- Joints are considered replicates



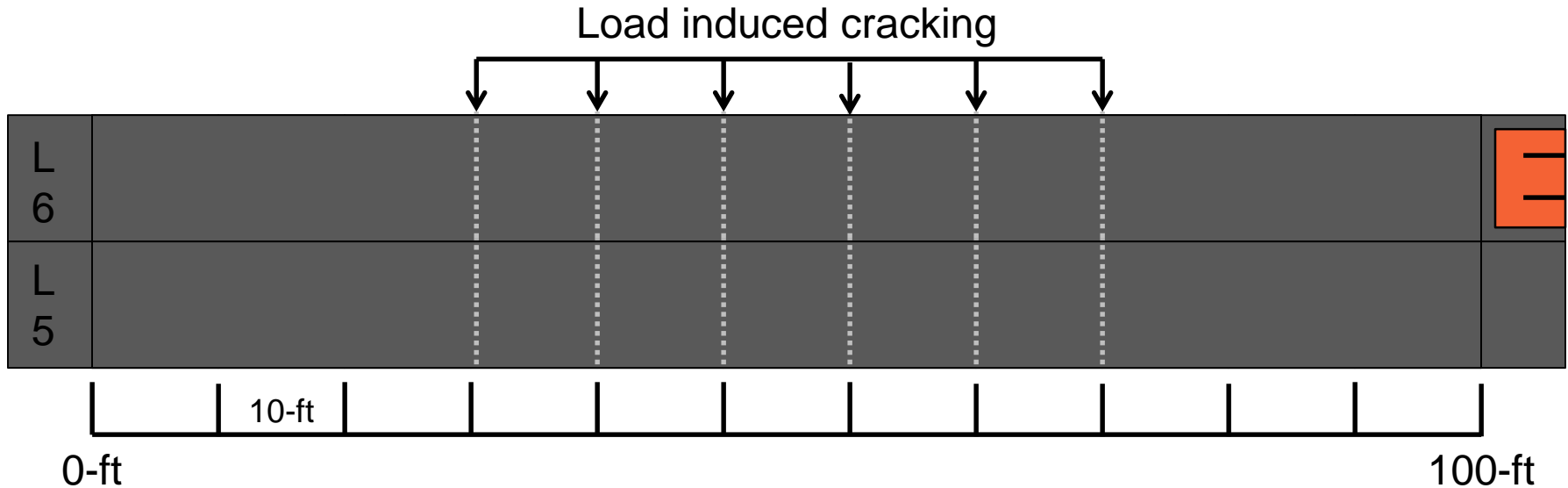
Section 2



- After lane cracks, move to the next lane



Section 2



- After total sections both lanes crack, compare!



How will we control cracking?

- Environmental effects
 - Temperature control (~40F with a/c and heating)
 - When not being tested, will be covered with concrete blanket to reduce UV and slab movement
- Vertical slab movement
 - Loading will be ramped up
 - 4.5-kip, 9-kip, 12-kip, etc.



How will we instrument?

- Strain gauges will be used to monitor slab movement
- Cracks will be tracked using high definition camera
- Crack maps will be generated and tracked with paint
- Falling weight deflectometer used before and after testing to measure slab deflections



Test

- 3" SMA-12.5 with PG64E-22 binder (control)
- 3" SMA-12.5 (control) + fiber reinforcing additive
- 3" SMA-12.5 + High Polymer
- 1" Interlayer + 3" SMA-12.5 (control)
- *Future...*
 - Cold Central Plant Recycled (CCPR) mix + SMA?
 - Saw-and-seal?
 - Your idea?



Expected outcomes

- Identify the most promising reflective crack mitigation treatments
- Establish APT method for testing future innovations in reflective crack mitigation
- Provide implementable results and recommendations to VDOT



Thank you!

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